California Environmental Protection Agency

Air Resources Board

Pleasure Craft Engine Evaporative Emissions Test Procedure

TP - 1501

Test Procedure for Determining Diurnal Evaporative Emissions from Pleasure Craft

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A set of definitions common to all Certification and Test Procedures are in Title 13, California Code of Regulations (CCR), section 2752 et seq.

For the purpose of this procedure, the term "ARB" refers to the California Air Resources Board, and the term "Executive Officer" refers to the ARB Executive Officer or his or her authorized representative or designate.

1. APPLICABILITY

This Test Procedure, TP-1501, is used by the Air Resources Board to determine the diurnal evaporative emissions from Pleasure Craft. This Test Procedure is proposed pursuant to section 43824 of the California Health and Safety Code (CH&SC) and is applicable in all cases where Pleasure Craft are sold, supplied, offered for sale, or manufactured for use in the State of California.

1.1 Requirement to Comply with All Other Applicable Codes and Regulations

Certification or approval of any evaporative emission control system by the Executive Officer does not exempt the engine or evaporative emission control system from compliance with other applicable codes and regulations such as state and federal safety codes and regulations.

1.2 Safety

This test procedure involves the use of flammable materials and operations and should only be used by or under the supervision of those familiar and experienced in the use of such materials and operations. Appropriate safety precautions should be observed at all times while performing this test procedure.

2. PERFORMANCE STANDARDS

The minimum performance standards for certification of evaporative emission control systems on Pleasure Craft is contained in CCR Title 13, Chapter 9, Article 4, section 2791.1.

3. PRE-CERTIFICATION REQUIREMENTS

3.1 Durability

A demonstration of durability of the applicant's evaporative emission control system is required prior to performing an evaporative emissions test.

Prior to the commencement of a durability demonstration, the applicant is required to submit and obtain approval of an evaporative emission durability test procedure. Once approved, a manufacturer is not required to obtain a new approval for an evaporative emission durability demonstration.

4. GENERAL SUMMARY OF TEST PROCEDURE

A Sealed Housing for Evaporative Determination (SHED) is used to measure diurnal emissions. This method subjects pleasure craft to a preprogrammed temperature profile while maintaining a constant pressure and continuously sampling for hydrocarbons with a Flame Ionization Detector (FID). The mass of total hydrocarbons that emanates from an evaporative control system over the test period is calculated using the ideal gas equation in 40 CFR section 86.117-96(d)(1).

This test procedure measures diurnal emissions from pleasure craft with complete evaporative emission control systems as defined in 13 CCR 2752 (a)(8). The basic process is as follows:

- Fill the pleasure craft's fuel tank with fuel
- Precondition the evaporative emission control and fuel delivery system
- Drain and fill fuel tank to 55% capacity with CFG III fuel
- Operate engine at 50% maximum governed speed for fifteen minutes to allow the engine to reach normal operating temperature
- Drain and fill fuel tank to 55% capacity with CFG III fuel
- Purge carbon canister (if so equipped)
- Operate engine at 50% maximum governed speed for fifteen minutes to allow the engine to reach normal operating temperature
- Subject the pleasure craft to a three-hour constant 105°F hot soak procedure
- Soak the pleasure craft for 6 hours at 65°F or until fuel temperature reaches 65°F
- Subject the pleasure craft to three 24-hour (65°F - 105°F - 65°F) diurnal temperature profiles

The highest 24-hour corrected diurnal mass of total hydrocarbons measured by the SHED over the three 24-hour diurnal temperature profiles is compared with the performance standards in CCR Title 13, Chapter 9, Article 4.7, section 2791.1. Evaporative control systems that meet the performance standard shall be considered compliant.

5. INSTRUMENTATION

The instrumentation necessary to perform evaporative emission testing for pleasure craft

engines is the same instrumentation used for passenger cars and light duty vehicles, and is described in 40 CFR 86.107-96.

5.1 Calibrations

Evaporative emission enclosure calibrations are specified in 40 CFR section 86.117-90. Amend 40 CFR section 86.117-90 to include an additional subsection 1.1, to read:

The diurnal evaporative emission measurement enclosure calibration consists of the following parts: initial and periodic determination of enclosure background emissions, initial determination of enclosure volume, and periodic hydrocarbon (HC) and ethanol retention check and calibration. Calibration for HC and ethanol may be conducted in the same test run or in sequential test runs.

5.2 Calculation of Hydrocarbon Mass

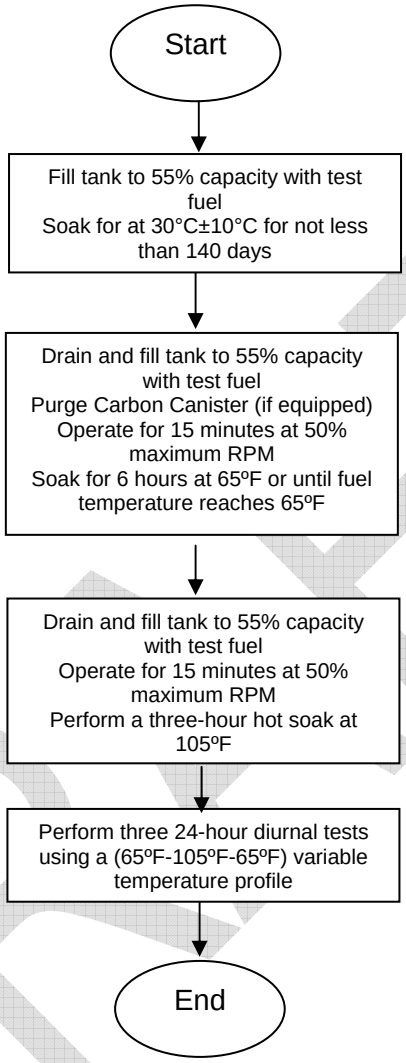
Calculate the final recovered hydrocarbon mass (M_{HC}) according to 40 CFR section 86.117-96(d)(1).

6. TEST PROCEDURE

The test sequence is shown graphically in Figure 1. The temperatures monitored during testing shall be representative of those experienced by the equipment. The equipment shall be approximately level during all phases of the test sequence to prevent abnormal fuel distribution. The temperature tolerance of a soak period may be waived for up to 10 minutes to allow purging of the enclosure or transporting the equipment into the enclosure.

Testing a representative piece of equipment for each evaporative family and comparing the results to the appropriate performance standard determines compliance with requirements of CCR Title 13, Chapter 15, Article 4, section 2791.1. The three day diurnal test sequence is shown in Figure 1.

Figure 1.



6.1 Fuel Tank / Fuel System Preconditioning

The purpose of the preconditioning period is to introduce gasoline into the fuel system and precondition all fuel system components. Precondition the tank and other fuel delivery system components by filling the tank to 55% of its nominal capacity with fresh test fuel as specified in Section 7 of these procedures. After filling the tank start the engine and allow it to run at 50% of the maximum rated speed for approximately ten minutes. Soak the tank and other components at 30º C $\pm$ 10º C for not less than 140 days. Data documenting that the tank has reached equilibrium must be provided for tanks soaked less than 140 days. The period of slosh testing may be considered part of the preconditioning period provided each tank and all fuel system components tested remain filled with fuel and are never empty for more than one hour over the entire preconditioning period.

6.2 Refueling and Hot Soak Procedure

Following the preconditioning period, drain the fuel tank and refill to 55 percent of its nominal capacity with test fuel. For evaporative emission control systems that use a carbon canister, the canister must be purged following the preconditioning period but prior to initiating the hot soak procedure. Purging consists of drawing 400 bed volumes of nitrogen or dry air through the canister at the canister manufacturer's recommended purge rate. Operate the engine at its maximum governed speed for fifteen minutes. Immediately place the engine in the SHED enclosure preheated to 105°F within two minutes. Perform a three-hour hot soak at a constant 105°F.

6.3 Forced Cooling

After the hot soak procedure, purge the enclosure to reduce the hydrocarbon concentration to near background levels. Cool the enclosure to attain a wall temperature of 65°F. After cooling the enclosure to 65°F, soak the Pleasure Craft in the enclosure for 6 hours at 65°F or until the fuel temperature reaches 65°F.

6.4 72-Hour Diurnal Test

Immediately after soaking, purge the enclosure to reduce the hydrocarbon concentration to near background levels and perform three (3) consecutive 24-hour diurnal tests using the temperature profile shown in Table 6-1.

Table 6-1.
Diurnal Temperature Profile

Hour	0	1	2	3	4	5	6	7	8	9	10	11	12
(°F)	65.0	66.6	72.6	80.3	86.1	90.6	94.6	98.1	101.2	103.4	104.9	105.0	104.2
Hour	13	14	15	16	17	18	19	20	21	22	23	24	--
(°F)	101.1	95.3	88.8	84.4	80.8	77.8	75.3	72.0	70.0	68.2	66.5	65.0	--

6.5 Calculation of Mass of Diurnal Evaporative Emissions

The calculation of the mass of the diurnal evaporative emissions is specified in Part III of the "California Evaporative Emission Standards and Test Procedures for 2001 and Subsequent Model Motor Vehicles."

7. TEST FUEL

Evaporative emission test fuel is specified in section 2262 of the "2007 AMENDMENTS TO THE CALIFORNIA PHASE 3 REFORMULATED GASOLINE REGULATIONS."

8. ALTERNATIVE TEST PROCEDURES

Test procedures, other than specified above, shall only be used if prior written approval is obtained from the Executive Officer. In order to secure the ARB Executive Officer's

approval of an alternative test procedure, the applicant is responsible for demonstrating to the ARB Executive Officer's satisfaction that the alternative test procedure is equivalent to this test procedure.

9. REFERENCES

1. California Evaporative Emission Standards and Test Procedures for 2001 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles, California Environmental Protection Agency, Air Resources Board, El Monte, CA, 2000.

2. California Exhaust Emission Standards and Test Procedures for 2001 and Subsequent Model Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles, California Environmental Protection Agency, Air Resources Board, El Monte, CA, 2002.

3. 40 CFR Part 86